

## **ACTUATION MECHANISM**

### **Background of the Invention**

#### **Field of the Invention**

**[0001]** The present invention relates to an actuation mechanism for the automated actuation of a clutch or a transmission in the drive train of a motor vehicle.

#### **Description of the Related Art**

**[0002]** Actuating devices of this type are known in the art from German Patent Publication No. DE 195 04 847. Due to their very large size, they need a relatively large space. But the space available in today's vehicles for arranging devices or assemblies is very limited, and because of an ever-increasing number of functions and features in today's motor vehicles, any existing space is divided among an ever-increasing number of devices.

**[0003]** An object of the present invention is therefore to provide a device that is smaller with respect to space requirements and yet, in view of functionality and longevity but also operating speed and actuating force, is as good as or better than the state-of-the-art devices.

### **Summary of the Invention**

**[0004]** In accordance with the invention, that object is achieved in a device for actuating an automated clutch or an automated transmission by providing a housing that has an axially-extending receptacle for receiving a toothed rack, whereby, further, a receptacle is provided in which a gear engages and meshes

with the toothed rack, whereby the gear can be driven by an electric motor through a transmission, and the electric motor together with the transmission and the gear can be fastened to the housing as a pre-assembled unit.

**[0005]** It is useful if the toothed rack is formed substantially as a cylinder and the receptacle for the toothed rack is formed substantially as a hollow cylinder.

**[0006]** It is also useful, furthermore, to provide an energy accumulator, such as a spring that is linked on one side, such as at an end area of the spring, to the toothed rack, and on the other side, such as at another end area of the spring, to the housing in the area of the hollow cylinder, wherein the toothed rack is movable in one portion of its longitudinal motion in a movement direction that is opposite to the force of the energy accumulator, and in another movement direction it is movable by the assistance of the energy accumulator.

**[0007]** It is advantageous if the energy accumulator is linked to the toothed rack by way of a protruding element.

**[0008]** It is also useful if the protruding element is at least a protruding catch, or a protruding ring, or a protruding edge of the housing.

**[0009]** It can be useful, in this context, if the protruding element is integrally formed with the toothed rack, or if it is formed in multiple pieces and then connected to the toothed rack.

**[0010]** It is also useful if the energy accumulator is linked to the housing by way of a protruding element.

[0011] Moreover, it is useful if the protruding element is at least a protruding catch or a protruding ring.

[0012] Likewise, in accordance with the invention, it can be useful if the protruding element is integrally formed with the housing, or if it is formed in multiple pieces with the housing and then connected to the housing.

[0013] In accordance with the invention, it is also useful if the connection is effected by an interlocking, a frictional locking, a force locking, or a material locking connection.

[0014] It is advantageous if the toothed rack is positioned in the receptacle of the housing for axial displacement, whereby its orientation is effected by two bearings that are each arranged, at a respective end area of the hollow-cylindrical receptacle. It can thereby be useful if the bearings are formed as bearing rings that can be inserted in the hollow-cylindrical receptacle and can be axially fixed. The axial fixation can be effected in one direction on a circumferential edge, or at least on a protrusion of the housing, whereby the axial fixation in the other direction is achieved by way of a retaining ring or snap ring that can be inserted in a groove.

[0015] It is also useful if one bearing ring serves as a bearing surface for the energy accumulator in the area of the housing.

#### Brief Description of the Drawings

**[0016]** The invention will be explained in more detail in the following description with the help of the embodiments that are represented in the drawing figures, in which:

**[0017]** Figure 1 is an exploded side view showing a device in accordance with the invention; and

**[0018]** Figure 2 is a bottom view, partially in section, of the device shown in Figure 1.

#### Description of the Preferred Embodiments

**[0019]** Figures 1 and 2 show a device 1 with a pre-assembled unit 2 that is essentially composed of an electric motor 3 that has a transmission coupled at its output side. The transmission is positioned within a transmission housing 4 and includes, for example, a worm gear pair (not shown), that includes a worm and a worm gear, whereby the worm is carried by the motor shaft and meshes with the worm gear. A further gear 5 is coupled with the worm gear and meshes with the toothed rack 10 of the device. Gear 5 is thereby rotated by electric motor 3 when the motor is actuated by a control unit (not shown). Gear 5 is carried on an axle that is supported in a receptacle 21 inside a housing 20.

**[0020]** Housing 20 has an axially-extending, hollow-cylindrical receptacle 22 that is open at each of its two end areas. Toothed rack 10 is inserted into receptacle 22 and is axially movable therewithin. Moreover, housing 20 includes a portion of receptacle 22 into which gear 5 extends when motor 3 is connected with housing 20 as a pre-assembled unit 2. Toothed rack 10 then meshes with

gear 5, whereby upon rotation of gear 5 toothed rack 10 moves in the axial direction. Gear 5 is located on an axle or on a shaft 6, and it is rotatable with the axle or relative to it. Axle or shaft 6 is supported inside housing 20 by way of a retainer 7 and is supported by it.

**[0021]** Bearings 30 and 31 are provided for supporting and centering toothed rack 10 within receptacle 22. Those bearings can advantageously be provided as journal bearings or as rolling bearings that in each case can fit at an end of housing 20 against a circumferential ridge within receptacle 22. A pair of retaining rings 32, 33 can be provided to axially secure the bearings in place. The retaining rings can be received as snap rings in a respective groove 34, 35, within receptacle 22 of housing 20. The bearings are thereby axially retained, and by matching the outer diameter of the bearings with the inner diameter of receptacle 22 the bearings are also radially fixed.

**[0022]** An energy accumulator 40 is arranged coaxially with toothed rack 10 and can be supported at one end by a protruding element 41 on the toothed rack, and on the other end by a protruding element 42 within receptacle 22. The protruding elements 41, 42 can be integrally formed with the toothed rack or the receptacle, respectively, or they can be connected with them in several pieces. It is useful if protruding element 41 is formed as a circumferential ridge and integrally with toothed rack 10. It is also particularly useful if the projection 42 is formed as a ridge and integrally with receptacle 22.

**[0023]** Element 50 represents a connecting element for connection with a release element of a clutch.

**[0024]** The actuator can be manufactured in an advantageous way if the axis of the toothed rack is arranged parallel with the axis of the electric motor. In other applications, it can also be useful for those two axes not to be parallel, but instead at a predetermined angle.

**[0025]** Furthermore, screwed connections can be provided between the electric motor and the housing by screws 60 and threaded openings 61.

**[0026]** The claims included in the application are illustrative and are without prejudice to acquiring wider patent protection. The applicant reserves the right to claim additional combinations of features disclosed in the specification and/or drawings.

**[0027]** The references contained in the dependent claims point to further developments of the object of the main claim by means of the features of the particular claim; they are not to be construed as a waiver of independent, objective protection for the combinations of features of the related dependent claims.

**[0028]** Although the subject matter of the dependent claims can constitute separate and independent inventions in the light of the state of the art on the priority date, the applicants reserve the right to make them the subject of independent claims or separate statements. They can, moreover, also embody independent inventions that can be produced from the independent developments of the subject matter of the included dependent claims.

**[0029]** The exemplary embodiments are not to be considered to be limitations of the invention. On the contrary, many changes and variations are

possible within the scope of the invention in the existing disclosure, in particular such variants, elements, and combinations and/or materials which, for example, are inventive by combining or modifying single features that are in combination and are described individually in relation to the general specification and embodiments as well as the claims and shown in the drawings, as well as elements or method steps that can be derived by a person skilled in the art in the light of the disclosed solutions of the problem, and which by means of combined features lead to a new object or new method steps or sequences of method steps, as well as manufacturing, testing, and operational procedures.